

Two New Species of *Dactylogyrus* (Monogenea: Dactylogyridae) from *Notropis alborus* (Pisces: Cyprinidae), with Comments on Inferred Host Relationships

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ABSTRACT: *Dactylogyrus albori* sp. n. and *D. onychoaccessorius* sp. n. are described from *Notropis alborus* Hubbs and Raney, 1947. *Dactylogyrus albori* differs from its closest apparent relative, *D. alabamensis* Rogers and Mizelle, 1966, most notably by possessing smaller anchors, hooks, and a copulatory complex. *Dactylogyrus onychoaccessorius* possesses a distinctive cirrus and 2-pronged accessory piece. Its relationship to other species of *Dactylogyrus* is uncertain, but it may be most closely related to *D. distinctus* Mizelle and Klucka, 1953. These parasites indicate that *N. alborus* may be more closely allied with the subgenus *Hybopsis* than with other *Notropis*.

KEY WORDS: *Dactylogyrus albori* sp. n., *Dactylogyrus onychoaccessorius* sp. n., *Notropis alborus*, Monogenea, Dactylogyridae, morphology, taxonomy.

Two new species of *Dactylogyrus* Diesing, 1850, are described from the whitemouth shiner, *Notropis alborus* Hubbs and Raney. Also, evolutionary relationships of *N. alborus* based on infesting *Dactylogyrus* are hypothesized in light of taxonomic revisions by Mayden (1989). This is the first report of any parasites from *N. alborus*.

Materials and Methods

Taxonomy of hosts follows Robins et al. (1991). *Notropis alborus* were collected through use of a minnow seine on 17 August 1978 and 28 June 1989. Immediately after capture, the fish were placed in jars containing a 1:4,000 formalin solution; after approximately 1 hr, enough formalin was added to make a 10% solution (Putz and Hoffman, 1963). The parasites, collected from the gills of their hosts, were mounted in glycerin jelly, and observations were made with a Zeiss phase-contrast microscope. Drawings were made with the aid of a Zeiss drawing tube. Measurements, in micrometers, were made as presented by Mizelle and Klucka (1953); means are followed by ranges in parentheses. Numbering of haptor hooks follows the scheme of Mueller (1936). Type specimens were deposited in the helminthological collection of the National Museum of Natural History (USNM) and the Harold W. Manter Laboratory, University of Nebraska State Museum (HWML). For comparative purposes, all original descriptions and redescrptions of North American *Dactylogyrus* species and specimens of the following species were examined: *D. alabamensis* Rogers and Mizelle, 1966, holotype (USNM 60782), 2 paratypes (USNM 60783); *D. amblops* Mueller, 1938, 7 syntypes (USNM 71453); and *D. heterolepis* Hanek, Molnar, and Fernando, 1975, 1 paratype (USNM 73158).

Results

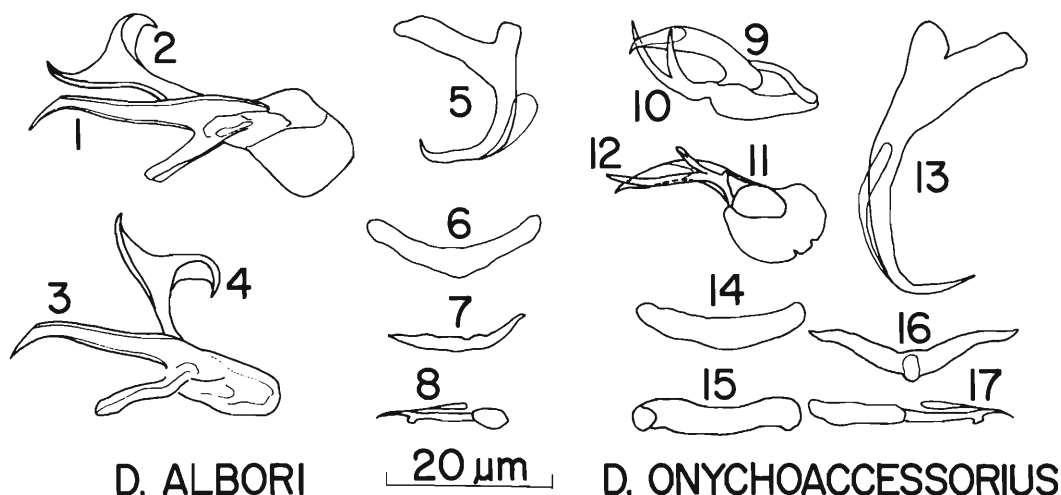
Dactylogyrus albori sp. n. (Figs. 1–8)

TYPE LOCALITY: North Carolina: Mecklenburg Co., Mallard Creek, U.S. Highway 29 bridge. Pee Dee River system.

TYPE SPECIMENS Holotype, USNM 82879; 19 paratypes, USNM 82880 (1 specimen), USNM 82881 (10 specimens), HWML 36608 (8 specimens).

LOCATION ON HOST: Gills.

DESCRIPTION: With characters of the genus *Dactylogyrus*, as emended by Mizelle and McDougal (1970). Body with thin tegument; length 283 (216–374), greatest width 74 (50–101). Two pairs of anterior cephalic lobes, lateral pair smaller than medial pair. Head organs not observed. Two pairs of eyes approximately equal in size, posterior pair usually farther apart than anterior pair. Pharynx circular to ovate (dorsal view), transverse diameter 21 (18–25), gut not observed. Peduncle usually present, 21 (11–35) long, 37 (28–46) wide. Haptor 39 (32–49) long, 53 (46–63) wide. Single pair of dorsal anchors; each composed of solid base with short deep root and elongate superficial root, solid shaft, and recurved point. Anchor length 18 (17–20), greatest width of base 14 (12–16). Dorsal bar length 20 (18–22). Vestigial ventral bar length 15 (11–22). Sixteen hooks (8 pairs), similar in shape (except 4A), normal in arrangement (Mizelle and Crane,



Figures 1–17. Sclerotized parts of *Dactylogyrus* species (drawings are of holotypes unless otherwise specified). 1–8. *Dactylogyrus albori* sp. n.: 1, 3 (USNM 82880), cirrus; 2, 4 (USNM 82880), accessory piece; 5, anchor; 6, dorsal bar; 7, ventral bar; 8, hook. 9–17. *Dactylogyrus onychoaccessorius* sp. n.: 9, 11 (USNM 82883), cirrus; 10, 12 (USNM 82883), accessory piece; 13, anchor; 14, 15 (USNM 82883), dorsal bar; 16, ventral bar; 17, hook.

1964). Each hook composed of solid base, solid slender shaft, and sickle-shaped termination provided with opposable piece (opposable piece lacking in 4A). Hook lengths: No. 1, 14 (11–15); 2, 15 (13–16); 3, 15 (14–18); 4, 16 (14–18); 4A, 6 (6–7); 5, 15 (14–16); 6, 14 (13–16); 7, 14 (13–15). Copulatory complex composed of cirrus and articulated accessory piece. Cirrus with rounded base bearing slender, usually straight process and slightly recurved tubular shaft that is attenuated to a point. Cirrus length 35 (32–39). Process length (measured from base of cirrus shaft to distal tip of process) 10 (9–12). Shaft length 28 (27–32). Accessory piece bifurcate, distal ramus curved and attenuated to a point; medial ramus a recurved blade, attenuated to a point. Accessory piece length 20 (15–23). Vagina sclerotized, irregular in shape, opening dextroventrally posterior to cirrus. Vitellaria obvious, usually distributed from pharynx to peduncle.

REMARKS: *Dactylogyrus albori* most closely resembles *D. alabamensis* by possessing similar-shaped anchors and cirrus, but comparison of type specimens and the original description of *D. alabamensis* (Rogers and Mizelle, 1966) reveals trenchant differences. The sclerites of *D. albori* are notably smaller. The dorsal bar of *D. alabamensis* is robust and v-shaped, whereas that of *D. albori* is more slender and gently curved.

ETYMOLOGY: *Dactylogyrus albori* is named after its host.

Dactylogyrus onychoaccessorius sp. n.
(Figs. 10–17)

TYPE LOCALITY: North Carolina: Mecklenburg Co., South Prong Clarks Creek, Asbury Chapel Road. Pee Dee River system.

TYPE SPECIMENS: Holotype, USNM 82882; 7 paratypes, USNM 82883 (1 specimen), USNM 82884 (3 specimens), HWML 36609 (3 specimens).

OTHER LOCALITY: North Carolina: Mecklenburg Co., Mallard Creek, Highway 29 bridge. Pee Dee River system.

LOCATION ON HOST: Gills.

DESCRIPTION: With characters of the genus *Dactylogyrus*, as emended by Mizelle and McDougal (1970). Body with thin tegument; length 294 (216–374), greatest width 57 (43–72). Two pairs of anterior cephalic lobes, lateral pair smaller than medial pair. Head organs not observed. Two pairs of eyes approximately equal in size, anterior pair ranges from farther apart to closer together than posterior pair. Pharynx circular to ovate (dorsal view), transverse diameter 21 (18–23), gut not observed. Peduncle 34 (14–84) long, 30 (21–49) wide. Haptor 46 (28–70) long, 65 (49–77) wide. Single pair of dorsal anchors; each composed of solid base with short deep root and elongate superficial root, and elongate solid shaft that curves to a sharp point. Anchor length 35 (33–36), greatest width of base 14

(13–15). Dorsal bar length 22 (21–22). Vestigial ventral bar with medial knob, length 23 (21–25). Sixteen hooks (8 pairs), similar in shape (except 4A), normal in arrangement (Mizelle and Crane, 1964). Each hook composed of solid base, solid slender shaft, and sickle-shaped termination provided with opposable piece (opposable piece lacking in 4A). Hook lengths: No. 1, 20 (18–23); 2, 22 (21–23); 3, 22 (19–25); 4, 25 (22–29); 4A, 6 (5–6); 5, 22 (21–24); 6, 21 (20–22); 7, 22 (21–24). Copulatory complex composed of cirrus and articulated accessory piece. Cirrus with base bearing robust curving shaft that attenuates to a point, length 25 (23–28). Accessory piece composed of 2 clawlike rami that are fused near the proximal end, length 14 (13–15). Vagina not observed. Vitellaria moderate, distributed from pharynx to peduncle.

REMARKS: *Dactylogyrus onychoaccessorius* possesses a distinctive cirrus and accessory piece. Its relationship to other North American species of *Dactylogyrus* is uncertain, but it may be most closely related to *D. distinctus*. Type specimens of *D. distinctus* could not be located; however, comparison of the original description (Mizelle and Klucka, 1953) indicates that the cirrus base is much larger and the cirrus shaft and accessory piece rami are much more robust in *D. albori* than in *D. distinctus*.

ETYMOLOGY: The specific name is from Greek (*onycho* = claw), referring to the clawlike accessory piece.

Discussion

Notropis alborus was originally compared with *N. atrocaudalis* Evermann, *N. bifrenatus* (Cope), *N. heterolepis* Eigenmann and Eigenmann, *N. stramineus* (Cope) (= *N. deliciosus* (Girard) and *N. ludibundus* (Girard)) (see Mayden and Gilbert, 1989), *N. procne* (Cope), and *N. volucellus* (Cope) (Hubbs and Raney, 1947). Although unable to determine precise relationships, ichthyologists have generally speculated that *N. alborus* is closely related to *N. heterolepis*, which has variously been placed in the *N. procne* species group (Snelson, 1971; Burr and Mayden, 1981; Page and Beckham, 1987), the *N. heterolepis* group as part of a "tooth reduction" group, which includes several of the preceding species plus some others (Coburn, 1982), and the *N. volucellus* group (Mayden, 1989). Coburn (1982) stated that the *N. heterolepis* group, which he thought should possibly include *N. alborus*, may share synapomorphies with the subgenus *Hybopsis* (sensu

Robins et al., 1991). Mayden (1989) concluded that *N. alborus*, but not *N. heterolepis*, shared synapomorphies with *Hybopsis* and thus transferred *N. alborus* to *Hybopsis*. Robins et al. (1991) did not include *N. alborus* in the subgenus *Hybopsis*.

Assuming that the Farenholz rule (co-speciation) is the prevailing pattern rather than homoplasy (co-accommodation) (Brooks, 1979), I hypothesize that the apparent close relationship between *Dactylogyrus albori* and *D. alabamensis* indicates that *N. alborus* is closely related to *Hybopsis* because *D. alabamensis* has been found only on species of *Hybopsis* (Mizelle and McDougal, 1970). In contrast, the apparent relationship between *D. onychoaccessorius* and *D. distinctus* indicates a possible relationship between *N. alborus* and the *N. volucellus* species group (which includes *N. heterolepis* according to Mayden [1989]) because *D. distinctus* has been reported only from *N. volucellus*. This possible relationship is further strengthened by *D. heterolepis*, found only on *N. heterolepis* (Hanek et al., 1975), being somewhat similar to *D. albori* and *D. alabamensis*. However, *D. albori* and *D. alabamensis* are apparently more closely related to each other than to *D. heterolepis*, indicating that *N. alborus* is more closely related to *Hybopsis* than to the *N. volucellus* species group, including *N. heterolepis*. These data also indicate that the *N. volucellus* species group, including *N. heterolepis*, may be fairly closely related to the subgenus *Hybopsis*. Further ichthyological and parasitological studies, including cladistic analyses of all species of hosts and parasites, are needed before the relationships between *Hybopsis* and the preceding groups of *Notropis* and their parasites will be thoroughly resolved.

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